Space Weather Technical Forecast

Issued on Thursday 21 November 2024 at 01:28 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: High Speed Stream solar winds bring a likelihood of enhanced geomagnetic activity from Day 1 (21 Nov).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate during the past 24 hours. The largest flare was a M1.1 at 20/1941 UTC, most likely from AR3897 on the southwestern limb.

There are currently eleven sunspot regions on the disc, four of which are unnumbered. AR3901 in the southeast is showing signs of magnetic complexity, but the possible small delta on its northern spot now appears weaker. AR3889 and AR3897 have either recently made it off the disc or are about to rotate of the southwestern limb respectively, but still pose a risk of both flares and protons from just beyond the limb. Two new regions have been added in the southwestern hemisphere, although currently appear to be small alpha spots. All other regions are relatively small and magnetically simple.

No Earth-directed CMEs were observed over the past 24 hours in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds at L1 remain in the Slow-Ambient regime, sitting around 370-380km/s. The solar wind density was near to below average, generally sitting between 4-7ppccm. The interplanetary magnetic field (IMF), Bt, was weak to moderate, peaking around 13nT in the early hours of yesterday morning. The north-south component, Bz, was mostly negative at the start of the period, peaking at -10nT. Then generally trending towards weakly positive. The phi angle was initially positive (away from the sun) then became rather variable, and finally trending towards being negative (towards the sun). The resultant geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was at Background to Moderate levels, with a diurnal peak of 146pfu observed at 20/1850 UTC. The associated 24-hour fluence remained below the Active threshold, and the 24-hour integrated flux observed at 21/0000 UTC was 1.91e6.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with any east limb arriving regions contributing to a chance of M-class flares and a persistent slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

Geomagnetic activity is expected to be dominated by High Speed Streams originating from CH93-/CH94-. Solar winds are expected to remain Slow-Ambient with speeds around 350-400km/s. Enhancement from CH93- will see wind speeds increasing to Slightly Elevated, around 450-500km/s by the late afternoon and evening on Day 1 (21 Nov), continuing into Day 2 (22 Nov). Then increasing again by Day 4 (24 Nov) from CH94-.

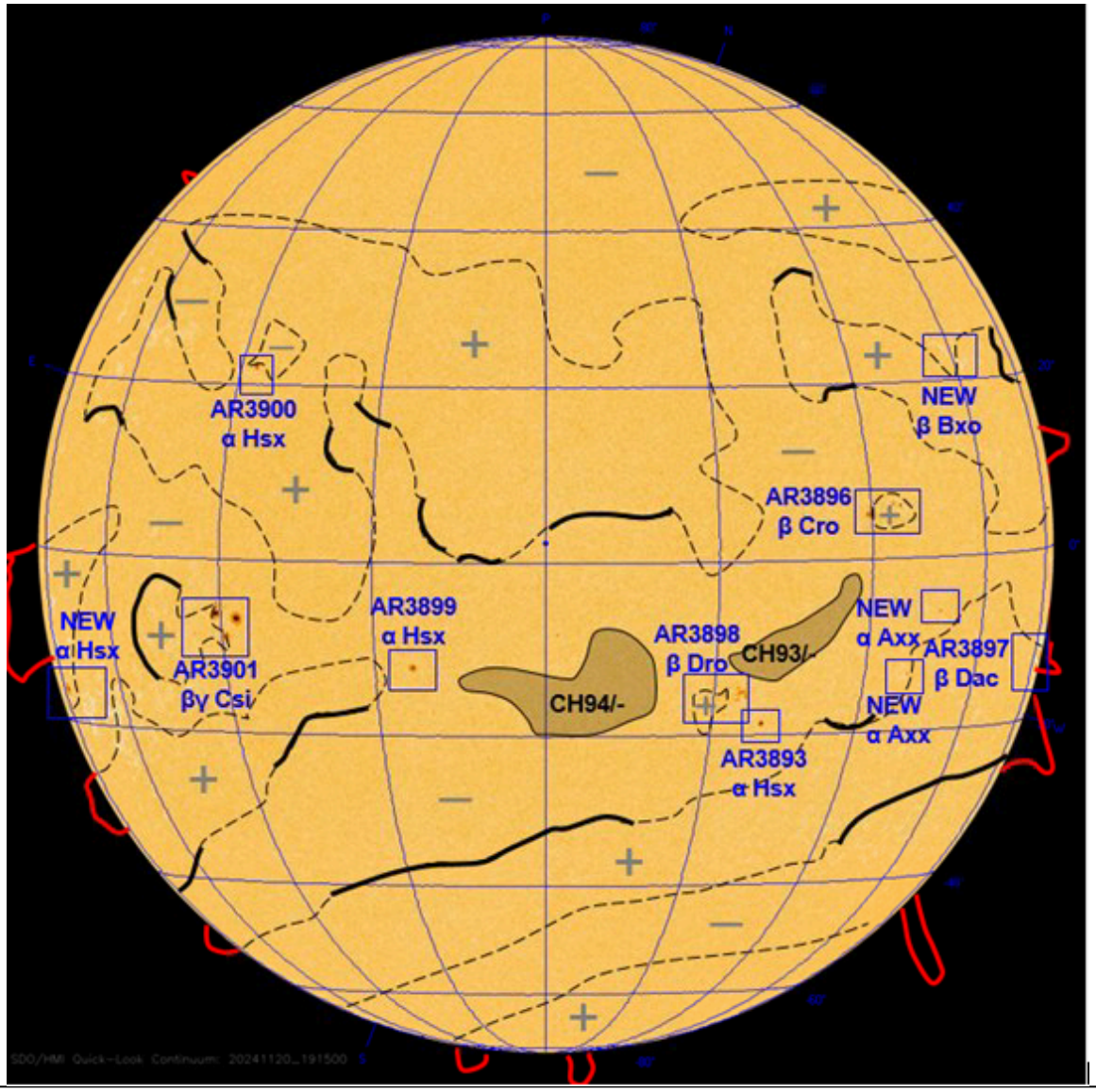
Generally, Quiet to Unsettled (Kp 1-3) conditions expected through much of the period, perhaps increasing through Day 1 and 2 (21-22 Nov) becoming Unsettled to Active (Kp 3-4) for a time, with a chance of G1 Minor Geomagnetic (Kp 5) Activity gradually waning on Day 3 (23 Nov), becoming mostly Quiet to Unsettled, with isolated Active intervals, especially at first. Geomagnetic activity increasing again by Day 4 (24 Nov).

Energetic Particles / Solar Radiation: There is a slight chance of S1/Minor Solar Radiation storms over the period, chiefly due to any potential significant flaring from ex-AR3889, and AR3897. High energy electron flux is likely to remain at background to moderate throughout the period. The associated fluence is expected to remaining below the Active (1e8 integrated flux) threshold.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1: Solar Synoptic Map valid 20/1915 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms

There are currently no Earth-directed CME's in the forecast.

Geomagnetic activity is expected to be dominated by High Speed Streams originating from CH93-, subsequently followed by CH94-. At the start of Day 1 (21 Nov) solar winds are expected to remain Slow-Ambient with speeds around 350-400km/s. As CH93- and CH94- passes further into the western hemisphere, wind speeds are expected to increase. Wind speeds are forecast to increase to Slightly Elevated, around 450-500km/s by the late afternoon and evening on Day 1 (21 Nov), continuing into Day 2 (22 Nov) as a result of CH93- . Later into the period CH94- may become more geoeffective, with again wind speeds becoming Slightly Elevated. The continued enhancement in solar winds to 550-600km/s as suggested by MOSWOC Enlil output during Day 1 (21 Nov) is viewed with caution, probably considered too high and too early to bring in any enhancement.

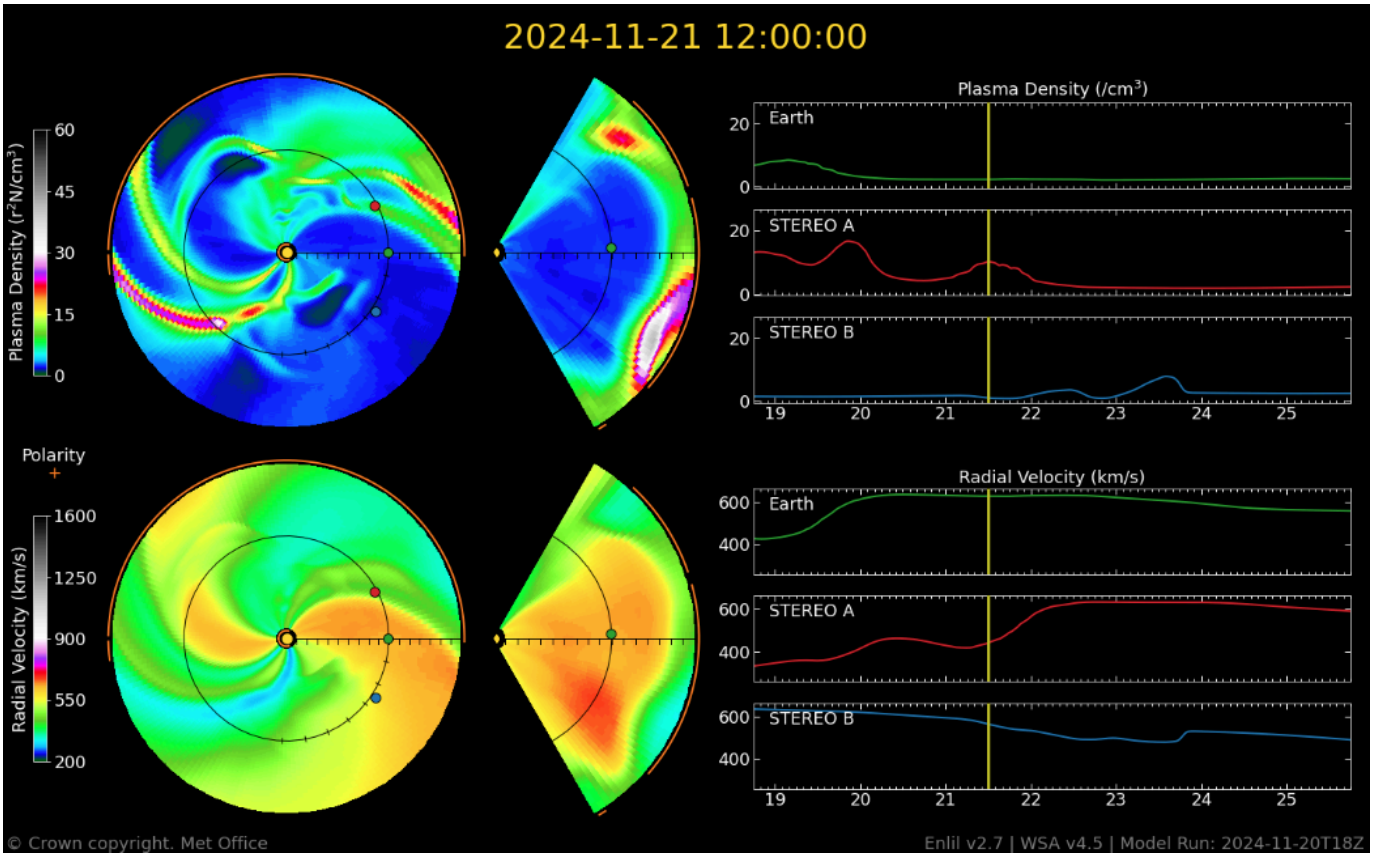
Quiet to Unsettled (Kp 1-3) conditions expected through much of the period. Activity perhaps increasing through Day 1 and 2 (21-22 Nov) becoming Unsettled to Active (Kp 3-4) for a time, with a chance of G1 Minor Geomagnetic Storm (Kp5) intervals depending on the strength of any enhancement from CH93- and CH94- and any associated CIR region. Activity gradually waning on Day 3 (23 Nov), becoming mostly Quiet to Unsettled, with isolated Active intervals, especially at first.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	20	20	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil output.



© Crown Copyright 2024. All Rights Reserved.

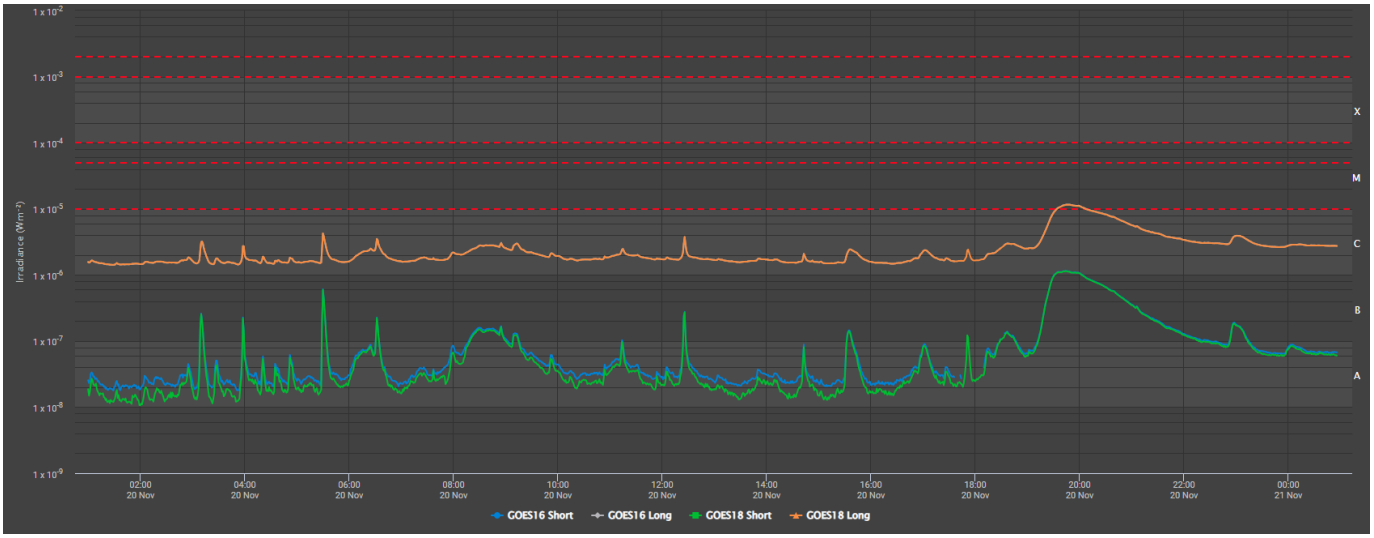
Radio Blackouts - X-Ray Flares

There are currently eleven sunspot regions on the disc, four of which are unnumbered. AR3901 in the southeast is showing signs of magnetic complexity, but the possible small delta on its northern spot now appears weaker. AR3889 and AR3897 have either recently made it off the disc or are about to rotate of the southwestern limb respectively, but still pose a risk of both flares and protons from just beyond the limb. Two new regions have been added in the southwestern hemisphere, although currently appear to be small alpha spots. All other regions are relatively small and magnetically simple.

Solar activity has been Moderate during the past 24 hours. The largest flare was a M1.1 at 20/1941 UTC, most likely from AR3897 on the southwestern limb. Low to Moderate activity is expected, with a chance of isolated Moderate flares and a slight chance of X-flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	Yes	50	50	40	40
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: X-ray flares. Note the M1.1 at 20/1941 UTC



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

There is a slight chance of S1/Minor Solar Radiation storms over the period, chiefly due to any potential significant flaring from ex-AR3889, now just around the western solar horizon, but also AR3897 which is following closely behind. The series of inbound eastern limb regions are unlikely to present any appreciable risk to the daily probabilities of S1 in the near term.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

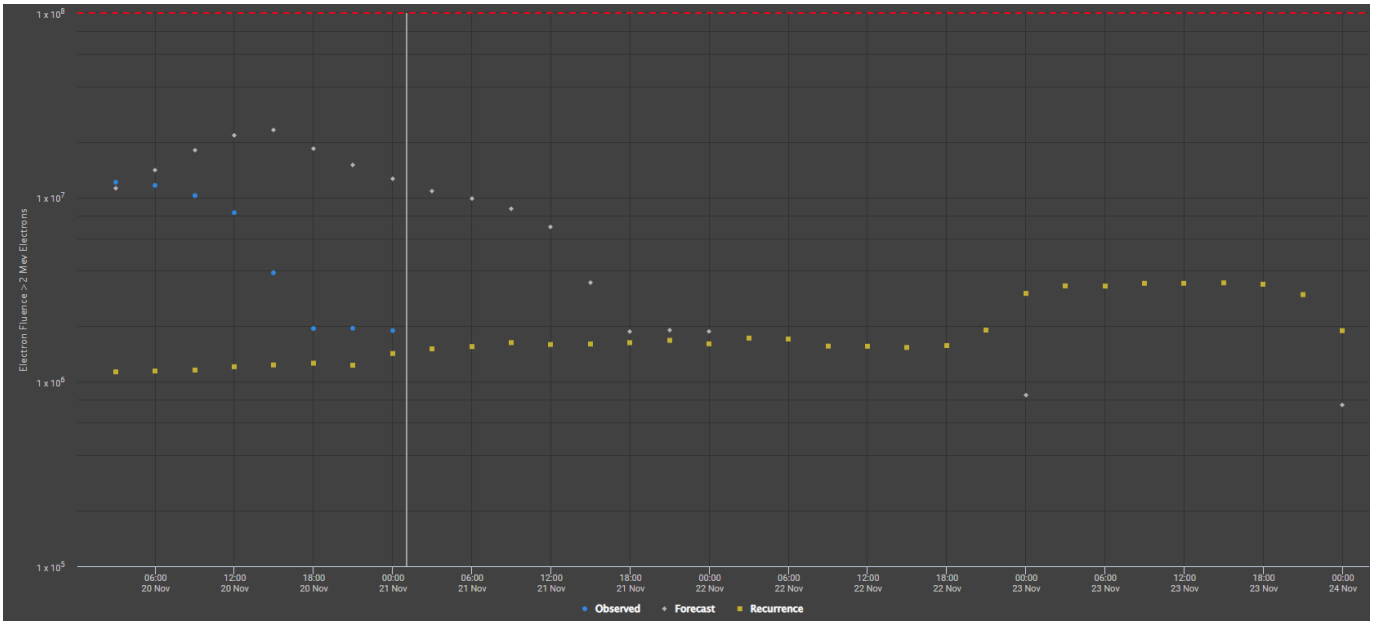
High Energy Electrons (≥ 2MeV)

Electron flux levels at GEO have been sitting fairly consistently at Background levels, but at times just about reaching Moderate. Electron levels are likely to trend downwards, sitting comfortably at Background levels as the Van Allen belt compresses due to increase solar winds from the connections into CH93-/CH94-. From Day 3 (23 Nov), electrons may temporarily increase as the Van Allen belt expands back to the location of GEO.

The initial values unlikely to be of sufficient magnitude to trouble the Active 24-hour integrated threshold - no persistent feature on the disc has resulted in Active fluence. MOSWOC REFM output viewed as providing reasonable guidance at present.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^8**	No	1	1	5	5
Very Active	**≥ 2 MeV ≥ 1×10^9**	No	1	1	1	1

Figure 4: MOSWOC REFM latest output.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.